REMARKS

In response to the Examiner's Action mailed on January 30, 2003, Fig. 1 and claims 1 to 20 are amended. The applicants hereby respectfully request that the patent application be reconsidered.

An item-by-item response to Examiner's objections or rejections is provided in the followings:

1. *Objections to Drawings*

The Examiner objects to Figure 1. Fig. 1 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 602.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: 100. A proposed drawing correction, corrected drawings, or amendment to The specification to add the reference sign(s) in the description, are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

In response to the objections, Figs. 1 to 3 are amended. The informalities as directed by the Examiner above are corrected.

2. *Claim Rejection – 35 USC § 112*

The Examiner rejects Claims 1-3, 10, and 13 ed under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification never states the word "adjacent", and it is not clear from the specification or the drawings what the definition of adjacent should be. Further, the examiner reads the word "adjacent" to mean "nearby" as stated by Webster's collegiate Dictionary, Tenth Edition.

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In response to the rejection, claims 1-3, 10 and 13 are amended and the terms "adjacent" are changed to specific location definition, i.e., - - right in front of - - , and - - at the exit of - -. These locations are clearly shown in Figs. 2 to 3 and no new matters are added by these amendment.

3. *Claim Rejection – 35 USC § 103*

The Examiner rejects claims 1-20 under 35 U.S.c. 103(a) as being unpatentable over Adibi et al. *(5,888,391)*, and further in view of Dawson et al. (6,111,260). According to the Examiner, regarding claims 1 and 10, Adibi et al. teach an ion implantation apparatus that contains a holder for a target substrate to be implanted and an ion source chamber that generates an ion beam (col. 3, lines 23-24 and Fig. 1). They teach the claimed deflection of charged particles in the ion beam to project towards the target along an angle different than the neutralized particles (col. 7, lines *50-57)*. They teach the use of a beam deceleration means that provides a deceleration electric field that reduces the energy of the ion beam (col. 2, lines 34-39). They also teach the blocking of neutralized particles in a mass selection chamber that prevents them from reaching the target for implantation. These neutralized particles propagate and will continue to fly in the direction of the beam ion and will be absorbed in the mass selection chamber, thus blocking them from being steered towards the target chamber (col. 7, lines *50-57)*. An electrostatic focusing field is established by applying a potential to a cylindrical electrode (col. 7, lines 1-5). This field is used to steer the neutralized particles in a different direction than the targeted ion beam path as described above. They teach that the beam deceleration optics (65) is located adjacent to the target chamber, but do not teach this deceleration optics deflecting the particles. However, the design is structurally identical to the applicant's and the intended use of the deceleration optics is not given patentable weight. Further, Dawson et al. teach a lens (134) tat is used to focus the ion beam for implantation (col. 5, lines 3-9 and Fig. I). It is clear from Figure 1 that this lens is positioned in an adjacent manner with respect to the target chamber. While this lens acts to focus the beam, the act of deflection is an obvious modification to this design. Further, this deflection would occur adjacent to the target chamber. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the deflection means of Adibi et al. to occur in an area that is adjacent to the target chamber, much like Dawson et al.,

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so that successful implantation of the ion beam will occur without a degradation due to neutralized particles.

Regarding claim 2, according to the Examiner that Adibi et al clearly depict the claimed analyzer magnet position (5) (col. 4, lines 24-26 and Fig. 1). Regarding claim 3 and 13, Adibi et al. teach disposing a deceleration optics further comprising electrodes adjacent to the target chamber (col. 5, lines 5 1-62). The functionality of the electrodes can easily be extended to perform the claimed functionality and as such is not given patentable weight. Regarding claims 4, 5, 11, 12, and 15, Dawson et al. teach disposing the target on a support at an inclined angle whereby the target is perpendicular to the charged particles (col. '7, lines 4-9). They also teach the use of a beam stop (130) that can be used to block the neutralized particles that are deflected in a manner described by Adibi et al. Regarding claims 6-8, and 20, Adibi et al. teach an ion beam steering means and beam deceleration optics generating an negative off-axis field by applying a potential is applied to the field electrode thus generating a negative electric field that decelerates the ion beam (col. 6, lines 66-67 and col. 7, lines 50-57). They also teach deflecting the charged particles of the ion beam as described above, but fail to teach a small, deflected angle relative to the horizontal axis. However. Dawson et al. teach steering the ion beam in the direction of the wafer target that is offset approximately 5 to 10 degrees relative to the horizontal axis for scanning thereof (col. 7, lines 4-9). Regarding claim 9, the above applied prior art makes use of a cryo-pump, but does not specify the pressure range of the chamber or the claimed ion beam energy levels. However, the teachings read on the claimed limitation, since one skilled in the art would reasonably estimate the pressure range be such so that the desired implantation will occur as claimed. In addition, Dawson et al, teach a target chamber maintained at a pressure that is less than 106 Ton (col. 7, lines 1-2). Dawson et al. also teach that ion energy levels from 15 - 40 key can be controlled (col.4, lines 40-41). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to provide a target chamber with a vacuum of 10^{-5} Torr and an ion beam energy level as low as 200 eV so proper implantation will occur. Regarding claims 14 and 16-19, the prior art discloses the claimed invention except for the appropriate beam-height to beam-width ratio. It would have been obvious to one having ordinary skill in the art at the time the invention was made to use an ion beam with the necessary height to width ratio for proper implantation, since it has

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been held that discovering an optimum value of a result effective variable involves only routine skill in the art.

In response to Examiner's rejections, claims 1 and 20 are amended to overcome the rejection under 35 USC §103. The amended claim 1 is directed to a method for performing an ion implantation comprising:

a) providing a target chamber for containing a target for implantation and an ion source chamber including an ion source for generating an ion beam;
b) disposing **right in front** of said target a beam deceleration optics that includes means for generating an off-axis electric field for decelerating and deflecting charged particles in **a vertically spread beam** of said ion beam to project toward said target along a deflected angle away from neutralized particles in said ion beam.

The amended claim 10 now directs to a method for generating an implantation ion beam from an ion source projecting a plurality of ions. The method includes:

a) disposing a beam deceleration means **right in front of** a target wafer of implantation for decelerating and deflecting charged particles **in said ion beam as a vertically spread beam** away from neutralized particles in said ion beam to project decelerated and deflected charged particles to said target wafer of implantation.

The amended claims 1 and 10 are new and totally non-obvious over Adibi in view of Dawson. Adibi does not have a deceleration means disposed right in front of the target chamber to generate an off-axis electrical field for decelerating and deflecting the charged particles away from the neutralized particles in the ion beam as now explicitly added into the claims 1 and 10. Dawson, as a magnetic focus lens does not deflect the beam into a vertically spread beam.

More specifically, a combination of Dawson and Adibi would not be sufficient to teach a device as now amended. Dawson applies a magnetic FOCUS LENS to focus the lens and then applies the focused

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beam to scan over the surface of a target wafer. The present invention is to spread the ion beam. First, the deceleration electrodes generate an electric field to separate the charge particles from the neutralized particles. Then, the deceleration electrodes project the charged particles to the target as a vertically spread beam. The charged particle beam has a height to width ratio of more than 4:1 as clearly discussed and claimed in this invention. A person would not find the magnetic focus lens useful to separate the charged particles from the neutralized particles. A focus lens is to focus, that is to project all the particles into a single point disregard the charges and mass of these particles.

Regarding the amended claims 1 and 10, a person of ordinary skill in the art certainly would NOT consider it reasonable to MODIFY a FOCUS LENS to SEPARATE the charged particle and the neutralized particles and to project the charged particles as vertically spread beam with a large aspect ratio to the target. Such application is totally against the inherent function of the FOCUS LENS. Therefore, the claims 1 to 20 as amended now would not be obvious over Adibi and Dawson and would be novel and patentable over these cited prior art references.

For the amendment set forth and the reasons provided above, the Applicants would like to respectfully request that Examiner's objection and rejections be withdrawn. Furthermore, the Applicants respectfully request that the amended Application be allowed and issued as a Patent.

Respectfully submitted for Jiong Chen et al.

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Version with Markings for Showing Changes Made

In the Claims:

(Twice Amended) 1.A method for performing an ion implantation comprising:

providing a target chamber for containing a target for implantation and an ion source chamber including an ion source for generating an ion beam;

disposing [adjacent to] right in front of said target [chamber] a beam deceleration optics that includes means for generating an off-axis electric field for decelerating and deflecting charged particles in a vertically spread beam of said ion beam to project toward said target along a deflected angle away from neutralized particles in said ion beam.

(Twice Amended) 2. The method of performing an ion implantation of claim 1 wherein:

disposing an analyzer magnet [adjacent to] right at an exit of said ion source chamber for mass filtering said ion beam.

(Twice Amended) 3.The method of performing an ion implantation of claim 1 wherein:

said step of disposing said deceleration optics further comprising a step of disposing electrodes [adjacent to] right in front of said target chamber for generating said off-axis electrical field for decelerating and deflecting said charged particles in said vertically spread beam of said ion beam.

(Same-Amended) 4. The method of performing an ion implantation of claim 1 further comprising:

disposing said target on a target support and disposing said target support at an inclined angle whereby said target is substantially perpendicular to a projection direction of said charged particles projected along said deflected angle.

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(Twice Amended) 5. The method of performing an ion implantation of claim 1 further comprising:

disposing a neutralized beam blocking means between said deceleration optics and said target [wafer chamber] for blocking said neutralized particle from reaching said target [chamber].

(Twice Amended) 6. The method of performing an ion implantation of claim 1 wherein:

said step of providing an ion source in an ion source chamber is a step of providing an ion source for generating a positive charged ion beam; and

said step of disposing said beam deceleration optics includes a step of disposing a means for generating a negative off-axis electric-field for decelerating and deflecting said charged particles in said ion beam as said vertically spread beam.

(Twice Amended) 7. The method of performing an ion implantation of claim 1 wherein:

said step of generating said off-axis electrical field for decelerating and deflecting said charged particles in said ion beam as said vertically spread beam is a step of deflecting said charged particles at a small deflected angle relative to a projected direction of neutralized particles.

(Twice Amended) 8. The method of performing an ion implantation of claim 7 wherein:

said step of decelerating and deflection said charged particles in said ion beam as said vertically spread beam comprising a step of deflecting said [ion beam] charged particles at a small deflected angle in a range of three to fifteen degrees relative to a projection direction of said neutralized particles.

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(Twice Amended) 9. The method of performing an ion implantation of claim 1 wherein:

said step of providing said ion source in said ion source chamber comprising a step of providing said ion source chamber and said target chamber with a vacuum of approximately 10^{-5} Torr; and

said step of decelerating and deflecting said charged particles is a step of decelerating said charged particles in said ion beam to an energy level as low as about 200 eV with an energy contamination of less than about 0.1%.

(Twice Amended) 10. A method for generating an implantation ion beam from an ion source projecting a plurality of ions comprising:

disposing a beam deceleration means [adjacent to] right in front of a target wafer of implantation for decelerating and deflecting charged particles in said ion beam as a vertically spread beam away from neutralized particles in said ion beam to project decelerated and deflected charged particles to said target wafer of implantation.

(Twice Amended) 11. The method of claim 10 further comprising:

arranging a wafer implant position with a small inclined angle relative to a projection direction of said neutralized particles corresponding to and substantially perpendicular to a projection direction of said charged particles for accepting said [ions] charged particles projected thereto.

(Twice Amended) 12. The method of claim 10 further comprising:

disposing a blocking means between said decelerating means and said target wafer for blocking said neutralized particles from reaching said target wafer of implantation.

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(Twice Amended) 13. The method of claim 10 wherein:

said step of disposing said decelerating means further comprising a step of disposing electrodes [adjacent to] <u>right in front of</u> said target for generating an off-axis electric field for decelerating and deflecting said charged particles away from neutralized particles in said ion beam.

(Twice Amended) 14. The method of claim 10 wherein:

said step of decelerating and deflecting said charged particles away from neutralized particles in said ion beam further comprising a step of decelerating and deflecting said charged particles into a high-aspect ratio beam having a [large] beam-height to beam-width ratio ranging substantially between 4 and 20.

(Twice Amended) 15.The method of claim 10 further comprising:

disposing a beam block between said deceleration means and said target wafer for blocking said neutralized particles. [propagating in a neutralized-particle direction.]

(Twice Amended) 16. The method of claim 10 wherein:

said step of decelerating and deflecting said charged particles away from neutralized particles in said ion beam further comprising a step of decelerating and deflecting said charged particles into a high-aspect ratio beam [and] having a ratio of a beam height to a beam width [equal or larger than] <u>ranging substantially between 4 and 20</u>.

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(Twice Amended) 17. The method of claim 16 wherein:

said step of deflecting said charged particles into a high aspect-ration beam [having a ratio of a beam height to a height to a beam width equal or larger than 20] comprising a step of providing an extraction aperture for said ion source with an aspect ratio [equal or larger than] 20] <u>ranging substantially between 4 and 20</u>.

(Twice Amended) 18. The method of claim16 wherein:

said step of deflecting said charged particles into a high aspect ratio beam [having a large beam-height to beam-width ratio] comprising a step of deflecting said charged particles into an ion beam having a beam-height to beam-width ratio equal or greater than 4.

(Twice Amended) 19. The method of claim 18 wherein:

said step of deflecting said charged particles into an ion beam having a beam-height to beam-width ratio equal or greater than 4 comprising a step of providing an aperture [of] <u>to</u> said beam deceleration means <u>wherein said aperture</u> having a beam-height to beam-width ratio equal or greater than 4.

(Twice Amended) 20. The method of claim 13 wherein:

said step of deflecting said charged particles away from neutralized particles comprising a step of deflecting said charged particles to project at an angle in [the] <u>a</u> range of three to fifteen degrees relative to a projection direction of said neutralized particles.

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